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the beginning of the latter period, as indicated by the glacial beds in New South Wales and other parts of Australia, has been suggested as the cause of the marked break between the two floras.

Fresh-water formations characterize the Triassic and Jurassic, but a subsidence with an extensive marine transgression took place in Australia during the Cretaceous, somewhat as in the other continents. But in the Tertiary neither marine nor lacustrine deposits of any importance are known to occur; the geological formations fail to provide an adequate record of the history and much of what is known is inferred from the topographic features. The history ends tamely, for the Pleistocene glaciation in Australia was limited in extent.

Because of the definiteness with which the subject-matter is handled, the book will be extremely useful to students in far-away countries who need the larger features and the bearing of the essential facts brought out clearly but concisely. A chapter is given to each geologic period and each chapter closes with a well-considered summary which emphasizes the most significant features of that particular period. The treatment is judicious and philosophic.

R. T. C.

History of Geology. By HORACE B. WOODWARD. New York: Putnam, 1911. Pp. 204.

This little volume is included in "A History of the Sciences" series, and well accomplishes the purpose of printing a history of geology in small compass. On the whole the work has been well done, but the reader will sometimes be inclined to think that perspective has been lost through the prominence given to English geologists of the pre-observational period. The author's judgment is not always unerring, as for example in the place accorded to the bombastic and imaginative De Luc. The effect of De Luc's activity, as viewed from this distance, would seem to have been chiefly to stem the advance of independent thought by such men as Hutton and Playfair, and to lead the reactionary elements within the church.

W. H. H.

LOWER CRETACEOUS OF MARYLAND

Under the simple title *Lower Cretaceous,* the State Geological Survey of Maryland issues what is in effect a monograph of the Lower Cretaceous formations of the state and their paleontology. For while the work consists mainly of the descriptions of all the fossils hitherto found in beds of that age in the state, a comprehensive though brief treatment of the stratigraphy, sediments, and geologic history of the formations furnishes more than a mere introduction and background for the paleontology. The volume combines the observations, experience, and knowledge of the three geologists, who more than anyone else have for many years been occupied with the study of these formations, William Bullock Clark, Arthur B. Bibbins, and Edward W. Berry.

In Maryland the Lower Cretaceous consists of three mutually unconformable formations, Patuxent, Arundel, and Patapsco, which collectively compose the Potomac group. For the benefit of those who may not have followed the progress of Atlantic Coastal Plain geology, it may be stated that no doubt is left as to the Cretaceous age of the oldest bed of the Potomac group. According to the conclusions of the authors the earliest Lower Cretaceous of the Atlantic coast in Maryland and Virginia was, after the long post-Newark hiatus, laid down in an old estuary or behind certain obstructive barriers. In this way they seem to compromise between the theory of California-gulf conditions of deposition proposed by McGee, on the one hand, and the absence of all types of marine life on the other. Account is, however, taken of the thinning of the beds to the eastward beneath the Tertiary overlap, as shown by drill records; of the fluviatile or lacustrine aspect of part of the Patuxent sediments; of the ancient forest soils and swamps of the Arundel; of the indications of differential warping, and of probable faulting near the "fall line." The average thickness of the Potomac in Maryland is between 600 and 700 feet and the average of the variable dips about 60 feet to the mile southeastward.

The Patuxent (lowest) formation, comprising a maximum thickness of 350 feet of cross-bedded sands and gravels, with some clays and kaolinized feldspar, is regarded as having been laid down in an estuary in a climate considerably warmer than that of today, within a region clothed with temperate rain forests, made up of a dense growth of ferns and cycads in more or less pure stands, with occasional conifers towering above the general level of the vegetation, which was relatively low, and gradually predominating in passing from the coast to the uplands. Growth rings in the petrified woods show seasonal changes, but the great width of the active growth ring and the narrowness as well as the irregularity of the zones of restricted growth suggest the occurrence of dry seasons rather than of frosty winters. It is certain that the winter cold was less than that of Maryland today. With the exception of one fish, the known Patuxent fossils are exclusively vegetal. They comprise about 100 species, most of them either Jurassic survivors or of Jurassic aspect. About forty of the species do not survive the relatively short hiatus following the Patuxent.

The Arundel formation consisting typically of drab, more or less lignitic clays, carrying iron carbonate or siderite in segregations of varying forms, attains a maximum thickness of perhaps 125 feet in the middle of the belt in central Maryland, whence it thins to the seaward, with a general dip to the southeast of about 50 feet to the mile. This formation has not furnished a rich flora, but it is remarkable as the source of all the saurian vertebrates, including eight dinosaurs and one crocodile, discovered in the Potomac group. It has furnished also the three fresh-water gastropods and one of the two fresh-water pelecypods. The Arundel flora, numbering but 33 species, four only of which are not known in either of the contiguous formations, is botanically much more closely bound to the underlying Patuxent than to the Patapsco. The vertebrates of the Arundel point toward Morrison age which Professor Lull, in agreement with Williston and many other geologists, is disposed to regard as Cretaceous, at least in part. The flora is apparently bound to that of the Kootenai, also Cretaceous. According to Berry the base of the Kootenai, so far as the latter is known by its fossil plants, is slightly older than the base of the Patuxent. Berry and Lull accordingly agree that the Patuxent and Arundel formations are of Neocomian and Barremian age.

A considerable hiatus (Aptian) appears to have elapsed before the Patapsco formation, embracing over 200 feet of sands and clays, notably variegated argillaceous material, covered and even considerably transgressed the areas of the Patapsco and Arundel. Of fossil animals, a single species, *Unio patapscoensis*, has been found in this formation. However, the Patapsco flora is both interesting and important. The contrast of the flora, embracing 83 species, is marked not only by extinction of the earlier plants (including 17 ferns, 24 cycadophytes, 1 ginkgo, 12 other gymnosperms, and all of the 7 supposed primitive angiosperms) but also by the introduction of higher forms of distinctly younger aspect. For in addition to the 41 Patuxent-Arundel species which survived from the older formations there are found 42 new types, including many unquestionable angiosperms. It appears that during the interval between Arundel and Patapsco time the dicotyledons which were destined so soon greatly to outnumber the plants of all other classes in the upper Cretaceous floras had already made a good start.

The limit of space forbids even mention of the wealth of philosophical botanical details regarding the development of the plant types, their relationships, associations, distribution, and so on. With the thoroughness characteristic of his method Berry not only describes all the species of fossil plants known from the lower Cretaceous in Maryland, but, as a basis for discussion and comparison, he summarizes all of the known lower Cretaceous floras of other parts of the world. The value of the latter treatment appears not only in his discussion of the age of the American plant beds, but in the broader correlations and in the historical outlining of the floras. His correlations show a refinement and precision that will surprise many who have not followed the recent studies of the Cretaceous floras of the Atlantic coastal plain. As already noted the Patuxent-Arundel flora, considered as a whole, is regarded by Berry as representing all but the lower portion of the Neocomian together with the Barremian. The Patapsco he correlates, on apparently good evidence, with the Albian, the Aptian of the old world being represented by the hiatus between the Arundel and the Patapsco. It may be noted in passing that a surprisingly large number of the previously recorded species of the Potomac formation fall into the ranks of synonomy as being in Berry's judgment not well founded.

Of the other well-known plant-bearing formations of the older Cretaceous in America, the Trinity is considered by Berry as representing the Aptian and the upper part of the Barremian. The Lacota formation, in the Black Hills, he views as transgressing lower on the Barremian and as falling short of the close of the Aptian, thus overlapping on both the Trinity and the Arundel, while the Fuson formation of the same region falls, he believes, within the Albian, though it is not so early as the basal portion of the latter. As already indicated, the Morrison-Kootenai beds he treats as probably Cretaceous, in which the Kootenai persisted to the close of the Barremian. On the California side the Knoxville-Horsetown beds are interpreted by him as reaching without break from the top of the Jurassic into the base of the Albian.

A map shows the distribution in Maryland of the Potomac group, the local stratigraphy and areal geology of considerable portions of which have previously been represented in greater detail in several folios of the U.S. Geological Survey.

David White